Mysore J. Agric. Sci., 50 (1) : 88-92, 2016

Study on the Feasibility of Making Silage from Maize Tops and its Nutritive Evaluation in Sheep and Goat

K. S. Giridhar, V. Nagabhushana, M. M. Venkatesha, G. U. Manju and B. D. Ravindra
Department of Animal Nutrition, Veterinary College, Shivamogga-577 204

Abstract

A study was conducted to find out the feasibility of making silage from maize (*Zea mays*) tops and its feeding value in sheep and goat. Silage prepared from maize tops was fed to sheep and goat for a period of 5 weeks, followed by 7 days of digestion trial. The properties of the silage such as colour, aroma, pH, moisture were observed to be optimum as compared to silage from the whole plant. The chemical and fibre composition of maize tops with respect to DM, CP, EE, NFE, NDF and ADF were similar to whole maize plant.

The intake (g/d) of maize top silage in sheep and goat was 425.7 ± 12.41 and 393.2 ± 16.64, respectively. The respective digestibility (per cent) of DM, CP, EE, CF, NFE in sheep and goat was 47.69 ± 1.21, 50.04 ± 1.40; 54.99±1.24, 57.93 ± 1.77; 56.75 ± 1.17; 58.44 ± 1.66; 49.86 ± 0.98, 50.96 ± 1.31 and 52.28 ± 1.38, 55.55 ± 1.38. The TDN and DCP content (Per cent) of Maize tops silage in sheep and goat were 47.42 ± 2.03, 49.60 ± 2.23 and 4.01 ± 0.21, 4.23±0.33 respectively. It was concluded that silage can be successfully prepared maize tops and fed to sheep and goat as a green roughage source.

In India, livestock production system facing severe shortage of roughage, especially, green forage due to cyclical lean and flush seasons. At present, we have a net deficit of 61.1 per cent green fodder, 21.9 per cent dry crop residues and 64 per cent concentrate feeds. (Chaudhary *et al.*, 2012). Projected demand of green forage supply is at 3.2 per cent as per 10th Five Year Plan Document, GOI. The area of cultivation of maize in India is about 87.1 lakh hectares and of Karnataka is about 13.1 lakh hectares accounting for 15 per cent of the total area of country (Anon., 2015 and NDDB, 2015). The aerial portion of the maize above the cob level (maize tops) after the dough stage, which is still sufficiently green is not required for the seed maturity which can be harvested and either fed green or converted to silage and fed to animals during lean season.

At present enormous quantity of maize top is not properly utilized rather most of roughage from maize fodder is wasted by drying. With this background, the present study was conducted to find out feasibility of making silage from maize top and its utilization in sheep and goat.

Material and Methods

Maize cultivation and silage making : CP-818 hybrid maize seed was selected for sowing during *Kharif* 2013 season for the purpose of grain production. Sowing was made after chemical treatment, at the seed rate of 6.0 kg / acre with spacing of 60×30 cm. The recommended dose of fertilizer used was NPK @ 60:30:20 kg / acre, 50 per cent of N and full dose of P and K was applied during sowing. After 30 and 65 days, remaining N was applied in equal dose. Regular cultural operation was followed as per university recommendation. The aerial part of maize plant (above the cob level) was harvested when the seeds attained dough stage. The moisture level of the maize top was estimated to be 59-60 per cent. Harvested maize top was immediately chaffed to a size of ½ to ¾ inches and filled into the silo immediately. For every 5 inch filling (about 1 ton), de-oiled rice bran @ 1 per cent was mixed in 25 litre water and sprinkled on the layers of chaffed maize tops to maintain optimum moisture level. The silo was filled, compacted and covered as per the standard procedures (Fig. 1).

Experimental animals and feeding : Six each male Bannur sheep and Osmanabadi goat of similar age and body condition were randomly selected from Sheep and Goat farm, Veterinary College, Shivamogga. The animals were placed in metabolic cages and given 5 week adaptation cum feeding period by offering

Chopping of maize tops

Addition of water and DORB

Feeding trial

Silage feeding to sheep and goats

Fig 1: Silage preparation and feeding

exclusively maize top silage followed by 7 day digestion trial.

Analysis of samples : Representative samples of maize tops was harvested from maize field and processed for dry matter and chemical composition. Pre-weighed maize top silage was offered every day and left over was collected next day morning. Fresh silage and silage residue samples were collected for physical and chemical composition (AOAC, 2000). Similarly, all the samples were also subjected for the estimation of fibre fractions and subjected to analysis for the proximate and Fibre composition (Goering and Van Soest, 1984). Daily total fecal output was recorded during digestion trial and two sets of samples were drawn, one for DM estimation and the other preserved in 25 per cent H_2SO_4 solution for N estimation. The pooled dried and wet dung samples were analysed later for proximate and fibre composition. The proximate content of silage and dung samples was computed for the determination of TDN and DCP content of maize top silage in sheep and goat. The data was subjected to statistical analysis as described by Snedecor and Cochran (1980) and results were interpreted.

Results and Discussion

Physical properties and pH of maize top silage : The Silage prepared from maize top was observed to be greenish to golden yellow in colour, sweet odour and pH ranging from 4.3-4.5 (Table I). The physical properties and pH observed in the silage from maize top were comparable (3.7-4.5) to the values obtained for the well preserved silage from the whole maize plant (Wilkenson, 2005; Seglar, 2003; O'kiely, 2011; Bareeba *et al.*, 1983).

Proximate and fibre composition of maize top silage : The comparative chemical composition of maize top and its silage is given in the Table II. Maize top and Maize top silage contained on an average 40.12 and 37.13 per cent DM, respectively. The CP, EE, CF, NFE and TA value (DMB) of maize tops was 6.5,

TABLE I

Physical properties of maize tops silage

Parameters	
Moisture	68-70 %
Colour	Yellowish to Yellowish green
Smell	Sweetish odour
pH	4.3-4.5
Palatability	Good

Mean of two replicates. Variation in duplicate measurements were within ± 3% of mean

0.95, 34.0, 49.85 and 8.7 per cent, respectively. Similarly, silage was having 7.30, 1.0, 35.0, 47.19 and 9.52 per cent respectively. As the maize tops were available for silage making only after the seeds attained dough stage, CP content was comparatively lower with higher DM content.

Bareeba (1983) reported 35 per cent DM and 5.6 per cent CP in silage prepared from maize stover. Richard (2013) harvested maize fodder during later stage got 35 per cent DM and 8.2 per cent CP. The stage of maturity of maize crop has direct influence on dry matter, while, CP content decreased with the stage of growth (Johannes, 2013 and NDDB, 2012). Suliman *et al*. (2013), Zbigniew Podkówka *et al*. (2011) and O'kiely (2011) also assessed maize silage and found 9.05 to 9.65 per cent CP and higher CF content with high DM content. Phipps *et al.* (2000) evaluated maize silages of wide divergent maturity from 23 to 38 per cent and opined that starch replaces the fibre as maturity. Higher CP value in maize top silage than fresh maize top may be due to addition of de-oiled rice bran during preparation of silage.

Fibre fractions in maize top silage : The average NDF, ADF, Hemicellulose, Cellulose and ADL values of Maize tops and Maize tops silage were 64.0 and 56.0; 38.0 and 40.0; 26.0 and 16.0, 29.0 and 28.0; 9.0 and 12.0 per cent, respectively (Table II). Fibre composition of maize top silage is in close confirmation with the same in whole maize plant silage (Table III). Basso *et al.* (2014) also found similar values in NDF and ADF (50.7, 29.2 %) and O'kiely

TABLE II

Chemical composition of maize tops and maize tops silage

	Maize Tops	Maize Tops Silage
Proximate composition on DMB %		
Dry matter	40.12	37.13
Crude protein	6.50	7.30
Ether extract	0.95	1.00
Crude fibre	34.00	35.00
Nitrogen free extractives	49.85	47.19
Total ash	8.70	9.52
Fibre fractions %		
Neutral detergent fibre	64.0	56.0
Acid detergent fibre	38.0	40.0
Hemicellulose	26.0	16.0
Cellulose	29.0	28.0
Acid detergent lignin	9.0	12.0

Mean of two replicates. Variation in duplicate measurements were within ±3 % of mean

TABLE III

*Chemical composition of maize fodder and maize silage**

	Maize Fodder	Maize Silage
Proximate composition %		
Moisture	80.0	70-75
Dry matter	20.0	25-30
Crude protein	10.86	7.90
Ether extract	1.79	1.10
Crude fibre	26.42	24.60
Nitrogen free extractives	51.83	55.10
Total ash	9.11	11.30
Fibre fractions %		
Neutral detergent fibre	62.25	45-50
Acid detergent fibre	34.14	25-30
Hemicellulose	28.11	15-20
Cellulose	29.81	10-20
Acid detergent lignin	4.33	4-8

(* Source: NDDB-2012)

(2011) found comparatively lower NDF and ADF (42.2, 24.5 %), while, Bareeba (1983) found higher NDF and ADF value (71.1, 45.5 %) in silage from maize stover. Fibre composition of maize crop varied largely due to plant maturity.

Feed intake and digestibility : Average daily feed intake of sheep and goats during different weeks of feeding trial are given in Table IV. The average daily feed intake (g/d) of sheep and goat was 425.7±12.41 and 393.2±16.64, respectively. During initial three weeks there was significant difference ($P<0.05$) in feed intake between sheep and goat, but, during the last two weeks there was no significant difference. The feed intake of maize top silage by sheep and goat was lower than the intake capacity of animal indicating the silage cannot form the complete ration. Forbes (2007) reported that factors such as fermentation end products, DM content of feed and length of cut all have an effect on ruminant intake, more so for sheep than cattle, with the average voluntary intake being 27 per cent lower when silage is fed compared to fresh herbage. In the present study some of these factors may be influenced the feed intake.

Digestibility coefficient of maize top silage is presented in Table V. Digestibility (%) of DM (47.69, 50.04), CP (54.99, 57.93), EE (56.75, 58.44), CF (49.86, 50.96) and NFE (52.28, 55.55) per cent in sheep and goat did not differ significantly. Digestibility (%) of CF in lambs reported as 60.26 (Venkateswarlu *et al.*, 2012) and 47.20 (Suliman *et al*., 2013) from maize silage, and digestibility of NDF in lambs was 54.2 per cent (Basso *et al.* 2014) and 44.6 per cent (Bareeba *et al.*, 1983). Comparatively lower fibre digestibility of maize top silage in the present study may be attributed to the stage of harvesting of the maize top.

TABLE IV

Average daily feed intake of sheep and goat during different weeks of feeding trial

Week	Feed intake (g/h/d)		
	Sheep	Goat	SEM
1 *	387.2 ± 6.72	335.7 ± 14.43	19.73
2 *	391.9 ± 7.57	348.7 ± 14.87	20.33
3 *	424.7 ± 9.82	384.3 ± 11.28	18.78
4	445.1 ± 9.82	430.5 ± 7.78	15.43
5	479.4 ± 10.85	466.7 ± 8.90	17.8
Avge	425.7 ± 12.41	393.2 ± 16.64	22.1

* means significant at $P<0.05$

TABLE V

Digestibility coefficient of nutrients of maize tops silage in sheep and goat

Digestibility coefficient %	Sheep	Goat	SEM
Dry matter	47.69 ± 1.21	50.04 ± 1.40	1.78
Crude protein	54.99 ± 1.24	57.93 ± 1.77	1.95
Ether extract	56.75 ± 1.17	58.44 ± 1.66	2.32
Crude fibre	49.86 ± 0.98	50.96 ± 1.31	1.77
Nitrogen free extractives	52.28 ± 1.38	55.55 ± 1.38	1.75
Nutritive Value			
TDN %	47.42 ± 2.03	49.60 ± 2.23	2.93
DCP %	4.01 ± 0.21	4.23 ± 0.33	0.33

Nutritive value : The TDN and DCP value (%) maize top silage were 47.42, 4.01 and 49.6, 4.23 in sheep and goat, respectively (Table V). Nutritive value in terms of TDN and DCP did not differ significantly between sheep and goat. Suliman *et al*., 2013 found that 47.76 per cent TDN and 5.56 per cent DCP in green maize stem silage to sheep. As per ICAR 1998 feeding standard, the requirement of DCP and TDN for sheep and goat weighing 21.41 and 20.79 kg body weight is 29.46, 271.5 and 29.21, 292.1 g / d, respectively. The DCP and TDN values of the present study indicate that the maize top silage may not provide adequate energy and protein if fed as a sole feed. Venkateswarlu *et al*. (2012) suggested that maize silage should be fed with concentrate at 1.5 per cent

body weight or legume hay at 25 per cent of dry matter requirement to obtain optimum growth rate.

Enormous quantity of maize top which is available can be harvested at dough stage and successfully conserved as silage for feeding sheep and goat during lean or drought period.

References

A.O.A.C., 2000, *Official Methods of Analysis.* 17th Ed. Association of Official Analytical Chemists, Washington, DC.2

Anonymus., 2015, India Maize Summit, Session 2 Transcript by Dr. Subbaiah, Govt of Karnataka, Initiatives for Enhancing the Production of Maize.

Bareeba, F. B. and Mcclure, K. E., 1983, Effect of Ensiling Maize Stover with Alfalfa or Urea on Intake, Digestibility and Nitrogen Balance by Growing Lambs. *Canadian Journal of Animal Science.* **63 :** 871.

Basso, F. C., Adesogan, A. T., Lara, E. C., Rabelo, C. H. S., Berchielli, T. T., Siqueira, G. R. and Reis, R. A., 2014, Effects of Feeding Corn Silage Inoculated with Microbial Additives on the Ruminal Fermentation, Microbial Protein Yield, and Growth Performance of Lambs. *J. Anim. Sci.* **92 :** 5640 - 5650.

Chaudhary, D. P., Ashwani Kumar, Sapna, S. Mandhania, Srivastava, P. and Kumar, R. S., 2012, Maize as Fodder? An alternative approach - Technical Bulletin, Directorate of Maize Research, Pusa Campus, New Delhi - 110 012, PP 32.

Forbes, J. M., 2007, Voluntary Food Intake and Diet Selection in Farm Animals : 2nd Ed., CABI, Wallingford, Oxfordshire, UK. 287 - 309.

Goering, H. K. and Van Soest, P. J., 1984, Forage Fibre Analysis, Agriculture handbook No.379. Agricultural research service, United States Dept. of Agriculture, Washington, DC.

Johannes, A. B., 2013, Maize Silage Based diets for Feedlot Finishing of Merino Lambs. MS (Animal Science) thesis submitted to Stellenbosch University, SA.

NDDB, 2012, Nutritive Value of Commonly Available Feed and Fodders in India. Animal Nutrition Group, **32** (1) : 83 - 86.

NDDB, 2015, Dairying in Karnataka - A Statistical Profile, Compendium: February. pp 112 - 113.

O'kiely, 2011, Intake, Growth and Feed Conversion Efficiency of Finishing Beef Cattle Offered Diets Based on Triticale, Maize or Grass Silages, or *ad-libitum* Concentrate. *Irish Journal of Agricultural and Food Research*. **50 :** 189 - 207.

Phipps, R. H., Sutton, J. D., Beever, D. E. and Jones, A. K., 2000, The Effect of Crop Maturity on Nutritional value of Maize Silage on Dry Matter Intake and Milk Production of Lactating Dairy Cows. *J. Animal Science.* **71 :** 401 - 409.

Richard, J. D., 2013. Milk Production from Silage: Comparison of Grass, Legume and Maize Silages and their Mixtures. *Agriculture and Food Science*. **12 :** 57 - 69.

Seglar, B., 2003, Fermentation Analysis and Silage Quality Testing. In: Proceedings of the Minnesota Dairy Health Conference. College of Veterinary Medicine, University of Minnesota, US. 119 - 136.

Snedecor, G. W. and Cochran, W. G., 1980, Statistical Methods. 7th Edn. Lowa state University Press, Ames, IOWA, USA.

Suliman, A. I. A., Baiomy, A. A. and Awad-allah., M. A. A., 2013, Productive Performance of Growing Lambs Fed Silages of Sugar Cane Tops, Sugar Beet Leaves and Green Maize Stems. *Egyptian J. Anim. Prod.* **50** (2) : 59 - 67.

Venkateswarlu, M., Ramana Reddy, Y. and Nagalakshmi, D., 2012, Effect of Feeding Maize Silage Supplemented with concentrate and Legume hay on Nutrient Digestibility in Nellore Ram Lambs. *Tamilnadu J. Veterinary & Animal Sciences*. **8** (6) : 368 - 376.

Wilkinson, J. M., 2005, Silage. Chalcombe Publications, Painshall, Church Lane, Welton, Lincoln, United Kingdom.

Zbigniew Podkówka and Lucyna Podkówka., 2011, Chemical Composition and Quality of Sweet Sorghum and Maize Silages. *Journal of Central European Agriculture*, 12 (2), p. 294 - 303.

(*Received :* November, 2015 *Accepted :* February, 2016)